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# ACTIVITY PATTERN AND TRAPPING BEHAVIOUR OF THE MALAYSIAN WOOD RAT (*RATTUS TIOMANICUS* MILLER) IN A COCOA-COCONUT PLANTATION

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*Keywords:* Temporal activity patterns, Trapping behaviours, *Rattus tiomanicus*, Cocoa-coconut plantation.

**RINGKASAN**

Corak pergerakan mengikut waktu bagi tikus belukar, *Rattus tiomanicus* (Miller), di ladang koko-kelapa telah diamati secara bilangan tangkapan setiap dua jam selama empat hari. Tikus-tikus didapati bergerak cergas pada waktu malam dan aktif di antara waktu senja dan subuh, di mana terdapat tiga waktu kemuncak (6 – 8 malam, 10 – 12 malam dan 2 – 4 pagi). Tikus dewasa (berat badan ≥90 g) adalah yang paling banyak ditangkap. Hasil tangkapan bagi tikus-tikus sepanjang 24 jam menunjukkan 73% ditangkap sekali, 22% dua kali, 4% tiga kali dan kurang daripada 1% empat kali daripada jumlah 610 tikus yang ditangkap kesemuanya. Hujan dan cahaya bulan dipercayai mempunyai pengaruh terhadap pergerakan tikus-tikus tersebut.

## INTRODUCTION

Knowledge of pest activity patterns is essential in pest management for the formulation of suitable control measures (MEASE and CHEESEMAN, 1969). Despite this need, little is known about this aspect of rats that are pests of cocoa.

This study investigates the activity pattern of *Rattus tiomanicus* (Miller), the most common and principal depredator of cocoa in West Malaysia (KAMARUDIN and LEE, 1981; KAMARUDIN, BAHARI and MAULUD, 1983). Factors relating to sex, weight, animal distribution and reproductive status were examined. The behaviour and response of the species to trapping were also studied.

## MATERIALS AND METHODS

The study was carried out at Kuala Bernam Estate, near Teluk Intan, Perak, West Malaysia on a 10 x 20 trapping grid covering approximately 0.74 hectare of cocoa interplanted with MAWA coconut. The experimental layout and trapping procedures had been previously described (KAMARUDIN, 1986).

Three 96-hour periods of continuous day and night trapping were carried out during 6–10 October 1980, 9–13 February 1981 and 15–19 June 1981. Traps were first set just before 1000h$^{+}$, with the first inspection at noon on the first day. After inspection, the coconut-meat baits were replaced with fresh ones, and the traps immediately reset. Thereafter, they were checked regularly at two-hourly intervals.

Trapped animals were identified to species, weighed, sexed, location and position the animal was trapped and reproductive status (male: testis scrotal or abdominal; female: vagina perforated or unperforated, pregnant or lactating) were recorded. Captured animals were then released immediately at their points of capture, and precautions were taken to prevent rats that had just been released from running back into the same traps. Observations at night were carried out using dry-cell battery-operated searchlights. Throughout the trapping periods, rain and the presence/absence of moonlight were noted.

The activity patterns of *R. tiomanicus* were measured by the number of captures

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$^{+}$As of 1 January 1983, the West Malaysian time was plus 0030 hours to those reported in this paper.

during specific time intervals, a procedure similar to those of BROWN (1956) and BLAUSTEIN and FUGLE (1981). The probability of equal capture and trapability of the rats were also computed following that of MITCHELL (1961).

## RESULTS

During the three sampling periods, the sun set at approximately 1830 h and rose at 0630 hours. A light drizzle was recorded between 1700 h and 2000 h for three evenings during February trapping. A full moon prevailed throughout the trapping period of June 1981.

### Activity Pattern

Throughout the sampling periods, out of 809 rats captured, 99% were caught between dusk and dawn (1800 h – 0600 h). Three activity peak periods at 1800 h – 2000 h, 2200 h – 2400 h and 0200 h – 0400 h were evident during most 24-hour periods *(Figure 1)*. During February 1981, however, only two activity peak periods at 2000 h – 2200 h and 0200 h – 0400 h occurred. The percentage capture between 0400 h and 0600 h during this sampling period was also found considerably higher as compared with the other periods.

Cumulative capture total data *(Table 1)* indicated that 21% (169 rats) males and females were caught between 0200 h and 0400 hours. A large number of newly captured males also coincided with this time period (11 rats or 35.5%), but for new females, large captures were observed between 2200 h and 0400 h (25 rats or 62.5%). The differences in the number of

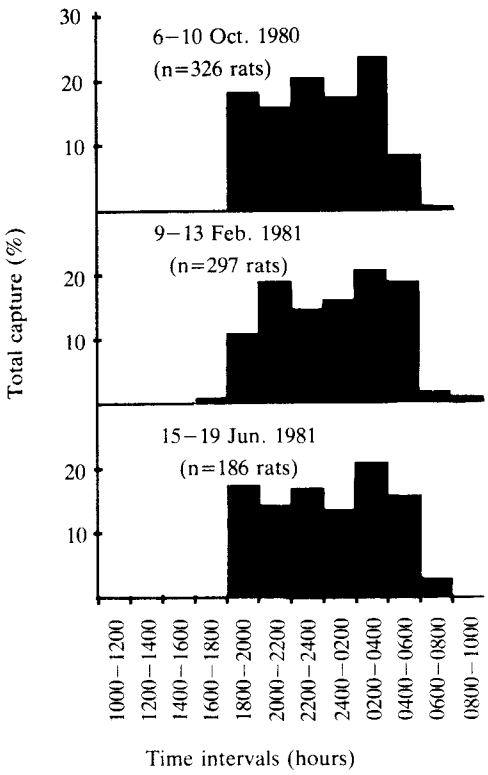
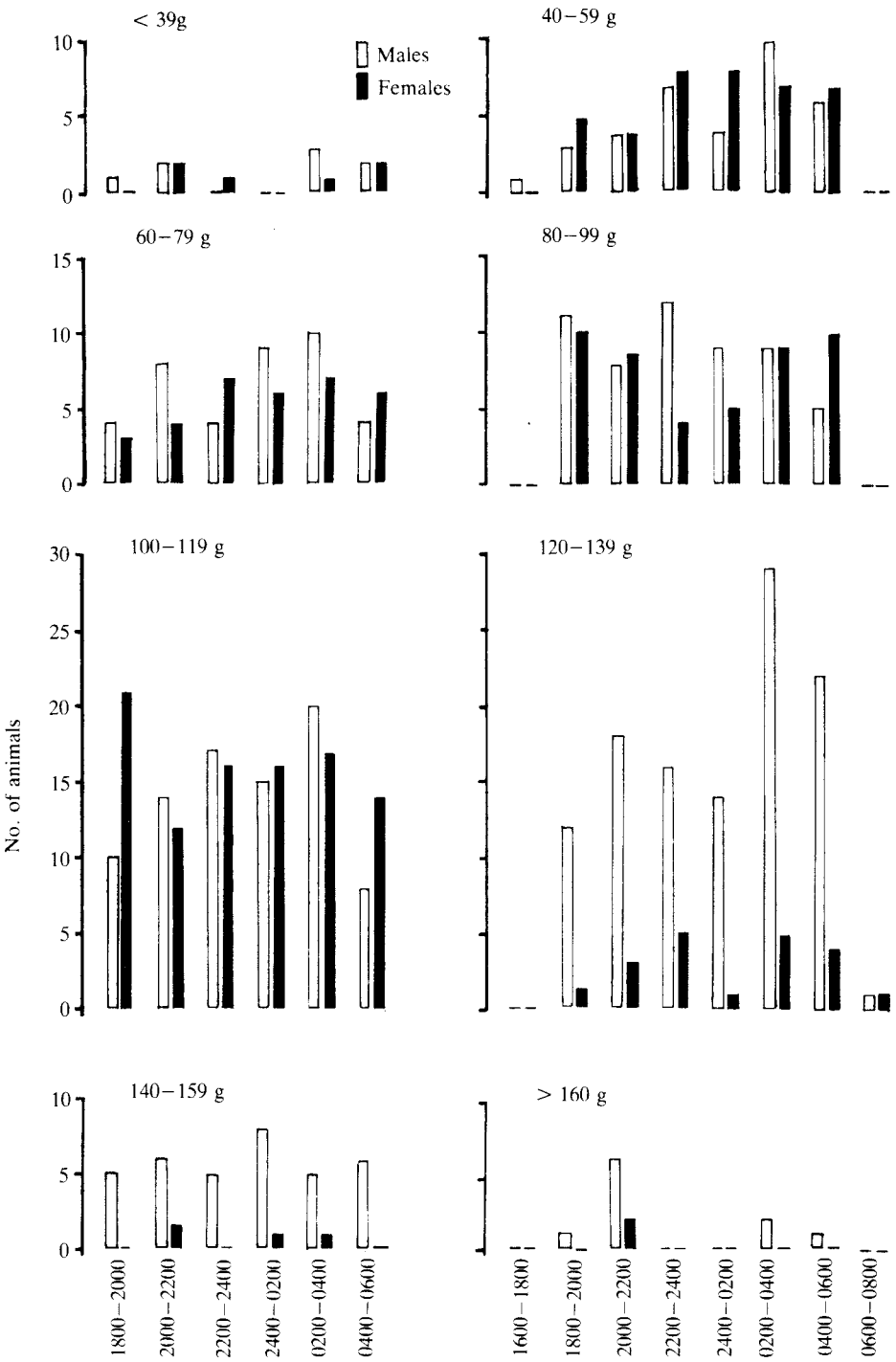



*Figure 1. Relative activity of* ***Rattus tiomanicus*** *(Miller) measured by the number of captures during 2-hour periods at 3 samplings.*

Table 1. Distribution of new and recaptured *Rattus tiomanicus* (Miller) of each sex by 2-hour trapping intervals cumulative of 3 samplings

| Time interval (hours) | No. of new captures | | No. of recaptures | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| 1600–1800 | 0 | 0 | 1 (50.0) | 1 (50.0) |
| 1800–2000 | 2 (1.6) | 6 (4.6) | 58 (44.6) | 64 (49.2) |
| 2000–2200 | 3 (2.3) | 4 (3.1) | 63 (48.5) | 60 (46.1) |
| 2200–2400 | 3 (2.2) | 8 (5.9) | 59 (44.4) | 66 (48.5) |
| 2400–0200 | 5 (4.0) | 9 (7.1) | 54 (42.9) | 58 (46.0) |
| 0200–0400 | 11 (6.5) | 8 (4.7) | 77 (45.6) | 73 (43.2) |
| 0400–0600 | 7 (6.4) | 5 (4.6) | 47 (43.1) | 50 (45.9) |
| 0600–0800 | 0 | 0 | 1 (25.0) | 3 (75.0) |
| 0800–1000 | 0 | 0 | 1 (50.0) | 1 (50.0) |

Values in ( ) are percentages.




Note: One animal captured during 1600h–2000h and 5 during 0600h–0800h were not graphed because of small sample size.

*Figure 2. Weight distributions of* ***Rattus tiomanicus*** *(Miller) at different times of capture intervals.*

males and females trapped during each time interval were statistically insignificant.

**Animal Size Distribution in Relation to Time Interval**

The sizes of animals trapped during the entire sampling periods varied between 18 g and 178 grammes. They were divided into eight weight classes of 20 g intervals *(Figure 2)*. It was observed that a large proportion of the females caught throughout the night weighed between 100 g and 119 g, and males weighed between 120 g and 139 grammes. There was no specific pattern between activity for a particular size of animal to a certain time interval. Rats weighing less than 39 g and greater than 160 g, however, were observed to be most active during the early part of the night (1800 h – 2200 h) and the morning hours (0200 h – 0600 h).

**Reproduction**

The distributions of males with scrotal testes and females with perforated vaginas during each time interval were not significantly different. In the male population, the proportion of scrotal males ranged from 83% to 100%, and for the females, those with perforated vaginas varied between 91% and 96% of the total male and female populations respectively. The proportion of pregnant females ranged from 22% to 45%, and they were captured mostly between 1600 h and 0600 h and were distributed evenly throughout. None were trapped later *(Table 2)*.

**Trapping Response and Behaviour**

From the cumulative total of all three sampling periods, 73% (447) of the animals were caught only once, 22% (135) twice, 4% (24) thrice, and less than 1% (4) four times *(Table 3)*. Testing for equal probability of capture between each sampling period revealed that individual rats were not caught with equal frequency.

Of the total number of rats that were trapped more than once, 36% were again captured during the same night if they had been caught for the first time between 1800 h and 2000 hours. Animals that were trapped the first time between 2000 h and 2200 h, had a 34% chance of being recaptured. Those caught between 2400 h and 0200 h had 8% chance of being retrapped, and those caught for the first time between 0200 h and 0400 h, only 3% were recaptured in the subsequent trapping intervals. None of the animals that were trapped after midnight were recaptured three or more times *(Table 4)*. The frequency of trapping the same rat more than once was greatest after a lapse of 4–6 hours from the time of their last capture *(Table 5)*.

Table 2. Reproductive status of male and female *Rattus tiomanicus* (Miller) at various intervals within a 24-hour trapping period cumulative of 3 samplings

| Time interval * (hours) | No. of males with scrotal testes | No. of females | |
|---|---|---|---|
| | | With perforated vaginas | Pregnant |
| 1600–1800 | 0 | 0 | 1 (100.0) |
| 1800–2000 | 41 ( 87.2) | 68 ( 94.4) | 32 ( 44.4) |
| 2000–2200 | 60 ( 90.9) | 59 ( 92.2) | 26 ( 40.1) |
| 2200–2400 | 52 ( 83.9) | 67 ( 90.5) | 33 ( 44.6) |
| 2400–0200 | 54 ( 91.5) | 61 ( 91.0) | 29 ( 43.3) |
| 0200–0400 | 73 ( 83.3) | 78 ( 96.3) | 34 ( 42.0) |
| 0400–0600 | 45 ( 83.3) | 52 ( 94.5) | 12 ( 21.8) |
| 0600–0800 | 1 (100.0) | 0 | 0 |
| 0800–1000 | 1 (100.0) | 0 | 0 |

*Other time intervals had no capture.
Values in ( ) are percentages.

Table 3. Frequency of repeated trapping of the same *Rattus tiomanicus* (Miller) individual during a 24-hour trapping period cumulative of 3 samplings

| No. of times captured | No. of rats | | | % |
|---|---|---|---|---|
| | Oct. '80 | Feb. '81 | Jun. '81 | |
| 1 | 195 | 151 | 101 | 73.29 |
| 2 | 54 | 51 | 30 | 22.13 |
| 3 | 5 | 12 | 7 | 3.94 |
| 4 | 1 | 2 | 1 | 0.64 |

Table 6. Trap occupancy by different *Rattus tiomanicus* (Miller) individuals during a 24-hour trapping period cumulative of 3 samplings

| No. of rats | No. of traps | | | % |
|---|---|---|---|---|
| | Oct. '80 | Feb. '81 | Jun. '81 | |
| 1 | 126 | 170 | 165 | 75.2 |
| 2 | 23 | 43 | 56 | 19.9 |
| 3 | 3 | 7 | 10 | 3.3 |
| 4 | 1 | 5 | 4 | 1.6 |

Table 4. Frequency of additional captures of *Rattus tiomanicus* (Miller) when the first capture occurred at various times cumulative of 3 samplings

| Time at first capture (hours) | Frequency of captures during the same night | | |
|---|---|---|---|
| | Twice | Thrice | Four times |
| 1600–1800 | 0 | 0 | 1 (0.6) |
| 1800–2000 | 47 (28.1) | 12 (7.2) | 2 (1.2) |
| 2000–2200 | 48 (28.7) | 7 (4.2) | 1 (0.6) |
| 2200–2400 | 26 (15.7) | 5 (3.0) | 0 |
| 2400–0200 | 13 ( 7.8) | 0 | 0 |
| 0200–0400 | 5 ( 3.0) | 0 | 0 |

Values in ( ) are percentages.

Table 5. Frequency of *Rattus tiomanicus* (Miller) recaptures with respect to time lapse from last capture within a 24-hour trapping period

| Time lapse from last capture | No. of rats | | | % |
|---|---|---|---|---|
| | Oct. '80 | Feb. '81 | Jun. '81 | |
| 2 hours | 11 | 19 | 10 | 21.5 |
| 4 hours | 15 | 25 | 16 | 30.1 |
| 6 hours | 18 | 22 | 14 | 29.0 |
| 8 hours | 10 | 13 | 6 | 15.6 |
| 10 hours | 3 | 3 | 1 | 3.8 |

Of all the traps that had occupants, 75% were occupied only once during the 24-hour trapping period. Twenty per cent of the traps caught two different rats, 3% of the traps caught three different rats, and only 2% of the traps had four different occupants during the 24-hour trapping period. Test for equal probability of trap occupancy during all three sampling periods showed that the traps were not equally occupied *(Table 6)*.

## DISCUSSION

*Rattus tiomanicus* is a nocturnal animal, and the period of greatest activity is between dusk and dawn. Similar findings had been reported for *Microtus* and *Reithrodontomys* species by HAMILTON (1937) and BLAUSTEIN and FUGLE (1981). DAVIS (1933) found a two to four-hour cycle of activity for *Microtus* species associated with feeding peaks at dusk and dawn. In *R. tiomanicus*, three peaks of activity were indicated. But rain during the early evenings of February 1981 sampling period evidently caused the rats to delay their activities and resulted in two peaks of activity. BROWN (1956) also found that the above-ground activity of *Clethrionomys* was influenced by rain. In his case, he found that when the rain started before the animals came above ground the animals would postpone their activity and a larger catch would follow. During the February 1981 sampling, where activity was delayed, a relatively larger capture of *R. tiomanicus* occurred later

between 0400 h and 0600 hours.

In the tropics where daylength does not vary very much throughout the year (OOI and CHIA, 1974), the main factors influencing rats' activity are probably rainfall and moonlight. Although there was no direct measure of the moon's illumination, the June 1981 sampling was during a full moon, and low number of *R. tiomanicus* captures resulted which probably suggested this correlation. HARRISON (1952) had reported that in nocturnal forest rats, conceptions were most frequent during periods before full moon which probably implied that activity was greatest during this time. He, however, found such activity pattern to a lesser extent in house and oil palm rats. An association between moonlight and animal activities had been established in temperate areas for beach mice (*Peromyscus polionatus*) by BLAIR (1951), in Fresno kangaroo rats (*Dipodomys nitratoides*) by LOCKARD and OWINGS (1974), and in *D. ordii* by KAUFMAN and KAUFMAN (1982).

The presence of moonlight had been inferred to cause high predation losses and this had been demonstrated by the high hunting success of foxes (KRUUK, 1964). The relative importance of moonlight on the principal predators of *R. tiomanicus*; snakes and owls, however, was not known.

The wood rat's response to trapping indicated that only 25% were repeaters. These repeaters were again trapped only if they had been captured previously during the early part of the night. Trapping of *R. tiomanicus* at two-hourly intervals showed unequal catchability. Such a behaviour is understandable since the rats probably would not have sufficient time to randomly mix before the next trapping commenced. Similarly, with the unequal probability of trap occupancy, random behaviour was not achieved.

## CONCLUSION

Information on the activity pattern of a pest species such as *R. tiomanicus* is useful in formulating control strategies. Control programmes using traps and poison baits especially would benefit if implemented in synchrony with the pest's most active period. Problems associated with trap failures and losses of baits as a result of long exposure of traps or baits to non-target species can also be minimized. The effects of rainfall and lunar cycle may also be important considerations during control campaigns.

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## ABSTRACT

Temporal activity patterns of the Malaysian wood rat, *Rattus tiomanicus* (Miller), in a cocoa-coconut plantation was monitored by their number of captures at two-hourly intervals. The rats are nocturnal and were found active between dusk and dawn. They exhibited three peak periods of activity during the night (1800 h – 2000 h, 2200 h – 2400 h, and 0200 h – 0400 h). Adults (body weight ≥ 90 g) were captured most. The trapping behaviour of the animal within a 24-hour period showed that out of 610 rats caught, 73% of them were caught only once, 22% twice, 4% thrice and 1% four times. Rainfall and bright moonlight seemed to affect their activities.

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